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of distinct stages, however, removes from the advocacy of the doctrine of "unity" the gravest objection which has heretofore lain against it, viz., neglect of important discriminations and confusion of formations diverse in age and nature. The degree of separation of the glacial stages recognized by Mr. Upham finds its maximum illustration in the retreat of the ice after the Kansan stage for a distance of 500 miles and its readvance about 350 miles, an oscillation which, if applied to Greenland, would eliminate and reproduce its ice-sheet.

Mr. Upham still urges the hypothesis of elevation as the chief cause of the Pleistocene glaciation. It seems not a little infelicitous to urge this doctrine in a work on Greenland, since the testimony of that region weighs heavily against the doctrine. At intervals along a thousand miles of the western coast it was observed by the present writer that a notable part of the mountainous border is rugged and angular and betrays no evidence of ever having been overridden by inland ice. A small driftless area was also discovered on the very border of the inland ice on Bowdoin Bay between latitudes 77° and 78° which shows more unequivocally that there has never been a general extension of the Greenland ice-sheet westward much beyond its present outline. The evidence of former elevation is as pronounced in Greenland as in any part of the northern hemisphere. It appears, therefore, that in this land of glaciers *par excellence*, the former elevation of two or three thousand feet or more was not accompanied by any great extension of glaciation, if indeed it was accompanied by any general glaciation at all. It appears, therefore, that the epeirogenic theory is weak on its most radical point — coincidence of elevation with glaciation — in its most promising region. To the writer it seems unfortunate that the public should be so industriously indoctrinated in a theory of the cause of the Ice Age which encounters such serious and seemingly fatal testimony in the very home of glaciation.

T. C. C.

Ice-Work, Present and Past. By T. G. BONNEY. International Scientific Series. New York: D. Appleton & Company.

FOR the past twenty years the author has written chiefly on petrological subjects. Many of his earlier papers, however, dealt with ice and its work, and this book is an expression of the revival of that earlier interest. He assigns as an especial occasion for adding another to the treatises on glaciology the predisposition of most authors to advocate some particular interpretation of the facts rather than to describe the facts themselves. He has made it his endeavor to follow the example of a judge rather than an advocate. To the extent of maintaining a judicial spirit he seems to have been quite successful. But in assuming to perform the functions of a judge he appears to have overlooked a prerequisite quite as essential as impartiality, viz., an intimate knowledge of the law and the facts in the case. Twenty years of specialization in petrology is scarcely an ideal preparation for donning the judicial ermine in the glacial *cause célèbre.* The inevitable lack of close familiarity with the glacial investigations of recent years is displayed throughout the work. It has led the author to depend upon other compilations, and these not always the best. As a result much of the matter does not come to the reader even at second hand. Haworth and Wright were evidently very serviceable in the preparation of the book. In some notable instances a compiler is quoted as authority instead of the original investigator, even when the original literature is easily accessible and well known. Further currency is given to some things which were doubtful at the outset and which have since passed beyond serious consideration, for example, the alleged benches 1700 feet above the surface of the Great Lakes, and the hypothetical Lake Ohio, based on the hypothetical Cincinnati ice dam. The lack of an intimate command of the subject also appears in the author's inability to adjudicate theories when it is quite possible to do so. This is pointedly illustrated in his summation of the hypotheses respecting the formation of kames and eskers, in which he says: "On the whole, rivers, swollen by melting ice and snow, seem the more probable cause, but it is still open to discussion whether kames and eskers are to be regarded as monuments of sub-glacial torrents or as marking the path of streams which, in the latter part of the glacial epoch, cut their way through expanses of soft and fine material which subsequently have been removed" (p. 168). The latter alternative is wholly beyond seriou consideration, as it is altogether inapplicable to the phenomena.

The work is divided into three sections, Part I, relating to the existing evidence as found in Alpine glaciers and in Arctic and Antarctic ice-sheets: Part II, relating to traces of the glacial epoch, in which lake basins and their relations to glaciers, the parallel roads of

Glen Roy, ice-work in Great Britain and Ireland, and in Europe and other parts of the world constitute the leading themes ; and Part III, relating to theoretical questions, especially the temperature of the glacial epoch, its possible causes, and the number of epochs. The discussion of the temperature of the glacial epoch embraces the largest amount of measurably unfamiliar material and is perhaps to be regarded as the most valuable part of the book. The description of alpine and polar glaciers is not brought up to date and is sadly lacking in suitable illustrations, for which abundant material now exists. In the discussion of the traces of the glacial epoch disproportionate attention is given to the excavation of lake basins, to the exclusion of erosive work in other lines quite as important, and the author's impartiality is not as well sustained here as elsewhere. Very much attention is given to the glacial phenomena of Great Britain, and relatively scant attention to that of Europe and America. It is natural that an English writer, presumably having in mind chiefly the English public, should give much prominence to home phenomena, but obviously in a work which takes on so comprehensive a title and is published as a part of an international series, the distribution of attention should be somewhat proportional to the development of the phenomena. In the discussion of the possible causes of the glacial epoch the author's judicial attitude appears to the best advantage. We think he is correct in concluding that "the glacial epoch has not yet received any satisfactory explanation." The literary style of the work is excellent, the language being clear and quite free from rhetorical coloration. The illustrations are not only scant and poor, but the selection is unfortunate in several cases, some of them being unworthy of reproduction.

T. C. C.

General Relations of the Granitic Rocks in the Middle Atlantic Piedmont Plateau, by G. H. Williams. (Fifteenth Annual Report, U. S. Geol. Surv., pp. 657–684.)

THE Piedmont plateau is classic ground in American geology. Within its limits many of the important problems of American science have been worked out, but by far the larger number of questions which it presents are yet unanswered. It is a region of great complexity. From the holocrystalline, undoubted igneous masses of the eastern border to the unchanged sedimentaries further west there is